Due on 31 March 2009, start of class

Please submit a paper copy in class.

CSE 355 Homework Four

1. 2.25. Page 130 of Sipser.
2. 3.1, 3.2. Page 159 of Sipser.
3. 3.6. Page 160 of Sipser.
4. 3.9(a). Page 160 of Sipser.
5. 3.15(b)-(e), 3.16(b)-(d). Page 161 of Sipser.

2.25 For any language $A$, let $\text{SUFFIX}(A) = \{ uv \in A \text{ for some string } u \}$. Show that the class of context-free languages is closed under the $\text{SUFFIX}$ operation.

3.1 This exercise concerns TM $M_2$ whose description and state diagram appear in Example 3.7. In each of the parts, give the sequence of configurations that $M_2$ enters when started on the indicated input string.

a. 0.
b. 00.
c. 000.
d. 00000.

3.2 This exercise concerns TM $M_1$ whose description and state diagram appear in Example 3.9. In each of the parts, give the sequence of configurations that $M_1$ enters when started on the indicated input string.

\[ \begin{array}{ll}
\text{a.} & 11. \\
\text{b.} & 1\#1. \\
\text{c.} & 1\#\#1. \\
\text{d.} & 10\#11. \\
\text{e.} & 10\#10. \\
\end{array} \]

3.6 In Theorem 3.21 we showed that a language is Turing-recognizable iff some enumerator enumerates it. Why didn’t we use the following simpler algorithm for the forward direction of the proof? As before, $s_1, s_2, \ldots$ is a list of all strings in $\Sigma^*$.

$E =$ “Ignore the input.
1. Repeat the following for $i = 1, 2, 3, \ldots$
2. Run $M$ on $s_i$.
3. If it accepts, print out $s_i$.”

3.9 Let a $k$-PDA be a pushdown automaton that has $k$ stacks. Thus a 0-PDA is an NFA and a 1-PDA is a conventional PDA. You already know that 1-PDAs are more powerful (recognize a larger class of languages) than 0-PDAs.

a. Show that 2-PDAs are more powerful than 1-PDAs.

3.15 Show that the collection of decidable languages is closed under the operation of

\[ \begin{array}{ll}
\text{a.} & \text{union.} \\
\text{b.} & \text{concatenation.} \\
\text{c.} & \text{star.} \\
\end{array} \]

3.16 Show that the collection of Turing-recognizable languages is closed under the operation of

\[ \begin{array}{ll}
\text{a.} & \text{union.} \\
\text{b.} & \text{concatenation.} \\
\text{c.} & \text{intersection.} \\
\text{d.} & \text{complementation.} \\
\end{array} \]

http://www.public.asu.edu/~ecolbon/src/355hw4s09.html

3/23/2009